State Water Resources Control Board

Winston H. Hickox
Secretary for Environmental Protection

Office of Statewide Initiatives
Economics Unit
1001 I Street • Sacramento, California 95814 • (916) 341-5272
Mailing Address: P.O. Box 100 Sacramento, California • 95812-0100
FAX (916) 341-5284 • ghorner@exec.swrcb.ca.gov

Gray Davis
Governor

TO: (1) John Norton
Chief, Office of Statewide Initiatives

(2) Jose Angel
TMDL Development
Colorado River Basin Regional Water Quality Control Board

FROM: Gerald Horner, Ph.D.
Economics Unit
Office of Statewide Initiatives

DATE: August 24, 2001

SUBJECT: NEW RIVER SEDIMENT TMDL: ECONOMIC ASSESSMENT

The staff of the TMDL (Total Maximum Daily Load) Coordination Unit, of the Colorado River Basin Regional Water Quality Control Board, has requested that the Economics Unit of the State Water Resources Control Board prepare an economic analysis of the costs involved with the proposed TMDL for silt in the New River Watershed.

This memo summarizes the results of the analysis of the implementation cost for the silt TMDL within the New River watershed. A comparison on a cost-share basis reveals that high cost scenario sediment reduction costs represent increases of less than 1% of gross production costs for field crops and vegetables. For non-vegetable row-crops, sediment retention costs are about 2 percent of total production costs.

For the purposes of the economic analysis, it was assumed that the set of existing farming practices for each crop provides the largest profit margin, and is therefore the least expensive set of practices, and any change in these methods would result in higher costs to the farmer. Included in this analysis is the costs related to alteration of existing farming practices in order to reduce sediment discharge from cropland. The cost of monitoring to be incurred by Imperial Irrigation District (IID) and the cost savings of maintenance accruing to the IID as a result of reduced sediment inflow into the drainage canal system are not included.

Also excluded from this estimate is the cost of compliance with IID Regulation No. 39 that requires maintenance and repair of the previously-installed standard "Tailwater Drop Boxes", with a maximum drop of 12 inches from field grade to top board height. Separate field surveys, performed in late 1999 and late 2000, have provided evidence that a significant percentage of these drop boxes are damaged, and that many are being used with drop elevations in excess of 18 inches, resulting in considerable field edge erosion. Since the maintenance of these structures is mandated by IID regulation, any costs incurred in repairing the existing damaged units are excluded from the current estimate.

Also excluded from this estimate are any costs that may be associated with any future TMDLs, not related to the current sediment TMDL for irrigated agriculture that may be developed for this region. The specific proposals have not yet been developed, and may not be completed for several years. Therefore, it is impossible at this time to determine the costs associated with the implementation of other possible standards.

The analysis of farming-practice costs related to reducing sediment loss was limited to an examination of current agricultural practices. The reduction of the quantity of sediment discharged into the agricultural drainage canals, from land being farmed, can be achieved by altering existing irrigation-related farm management practices. The amount of land erosion from an individual field, and subsequent sediment discharge into the drainage system, is dependent upon the following factors:

1. flow rate of water runoff;
2. flow rate of water inflow;
3. soil type;
4. irrigation method;
5. field size;
6. crop;
7. tailwater ditch characteristics;
8. drop structure characteristics.

Of these various factors, it is generally agreed that the most important factor is the flow rate of water runoff, or irrigation discharge. The second most important factor may be the soil type. The specific crop being irrigated has a relatively small impact upon the rate of sediment discharge into the drainage system but crop type may require specific irrigation methods and thus affect sediment reduction costs. Field size also affects sediment retention costs because of the inherent economies of size in some techniques such as sediment ponds and drainage filters.

The Alamo River TMDL Technical Advisory Committee (TAC) submitted a list of possible irrigation-related farm management practices that could result in reduced sediment discharge. This list consisted of eight somewhat-related practices involving the control of drainage water. The University of California Cooperative Extension (UCCE) staff of Imperial Valley Research Field Station prepared an additional list of ten management practices. These ten practices have some overlap with the eight submitted by the TAC and a combined list of approximately twelve to fifteen management practices was formulated that could be incorporated into existing farming practices. These practices were assumed to be applicable to the New River watershed.

However, only a small number of these appeared to be potentially economically feasible, as well as culturally feasible in a situation of high-salt-content irrigation water. Management practices that were judged to be effective in reducing sedimentation include:

- Installation of biodegradable fibermat filter strips in the drainage ditches. These can be used at strategic locations in the drainage area to act as water "speed bumps", to slow the surges of tailwater leaving the field through the drop-boxes. The per acre cost of using FIBERMAT filter strips decrease as field size increases.
- Construction of wide-profile drainage ditches incorporating grass-planted filter strips. As the grass roots hold the soil, and the grass itself acting to slow the movement of the tailwater, the tailwater surges would become less erosive. The per acre cost of wide profile ditches and grass-planted filter strips decrease as field size increases.
- Construction of sediment basins to contain drainage water in order to allow suspended sediments to settle out. The captured sediments are dredged out periodically. Sediment basins are suitable for fields larger than 140 acres.
- Employing an additional irrigator to monitor the irrigation and employ alternative irrigation techniques. Employment of additional irrigating labor will not necessarily result in reductions in applied water, but will result in elimination of the surges of discharge water, identified as the primary cause of sediment discharge. The cost of improving the management of irrigation water does not fluctuate with respect to field size.

Each of these management practices is feasible, practicably or economically, under certain conditions. These conditions can be crop-specific or field-specific. In some cases, individual preference may also be a factor. In addition, more than one practice may be needed to adequately reduce sediment losses from a specific field.

Costs associated with the individual irrigation management practices were estimated from material suppliers and contractors and are summarized in Table 1 by four field sizes and several crop types. Cost estimation procedures and assumptions are presented in Appendix 1. Annual costs range from a low of just over $2 per acre for the grass lined, wide-profile ditch servicing a 160-acre field to a high of about $42 per acre for additional vegetable and row crop irrigation labor used on a small field.

As seen in Table 1, costs of sediment retention decrease as field size increases and therefore plays a significant role in determining the costs of achieving the TMDL and estimating the economic impact to growers. The number of Imperial County fields by size and crop category is presented in Table 2. Field size data were collected by the California Department of Pesticide Regulation as part of the pesticide application permit process. These data were aggregated by crop and size category for 1998.

Table 1. Annual Costs of Sediment Retention Management Practices.

Practice	Annual Cost per Acre			
	40 Acres	60 Acres	80 Acres	160 Acres
Fibermat Filter Strips	$32.56	$26.58	$23.02	$16.28
Grass Filter Strips				
3-year Installation	$5.99	$4.89	$4.24	$3.00
5-year Installation	$4.28	$3.49	$3.02	$2.14
Sediment Pond	—	—	—	$20.10
Additional Irrigation Labor				
Veg. & Row Crops				
Lettuce	$31.50	—	—	—
Cotton	$35.00	—	—	—
Melons	$28.00	—	—	—
Watermelons	$35.00	—	—	—
Carrots	$28.00	—	—	—
Onions	$42.00	—	—	—
Hay Crops				
Alfalfa	—	—	$9.20	—
Sudan	—	—	$3.45	—
Tree Crops	—	—	$7.50	—

Table 2. Number of Fields by Size and Crop Category, Imperial County 1998.

Crop Category	Field Acreage					Totals
	<=40	>40<=60	>60<=80	>80<=160	>=160	
Hay and Forage	304	178	578	303	42	1,405
Vegetable Crops	262	81	324	94	8	769
Row Crops	150	73	308	189	7	727
Citrus	4	2	1	2	0	9
Total All Crops	723	335	1,214	591	58	2,921

Source: California Department of Pesticide Regulation.

Approximately 42 percent of Imperial County crop fields are in the 60 to 80 acre range and 78 percent are 80 acres or smaller. Since most of the fields are classified in the smaller field sizes, higher than average sediment retention costs can be expected.

A high and low cost estimation of sediment retention was estimated for the New River watershed using data developed for Imperial County. This assumes that the crops grown and field sizes in the New River watershed are representative of the county.

Effectiveness of the sediment retention management practices depends on the specific field conditions and a combination of practices may be needed to achieve certain sediment load reductions. A combination of sediment retention practices that includes additional irrigation labor and grass lined filter strips is assumed as the basis for the high cost scenario (Table 3).

Table 3. High Estimate of Annual Costs of Sediment Retention by Fields Size and Crop*

Crop	Field Acreage				
	<=40	>40<=60	>60<=80	>80<=160	>=160
Alfalfa (172,000 ac.)	$13.48	$12.69	$12.22	$11.34	$11.34
Lettuce (29,000 ac.)	$35.78	$34.99	$34.52	$33.64	$33.64
Sugar Beets (36,000 ac.)	$39.28	$38.49	$38.02	$37.14	$37.14
Citrus (4,900 ac.)	$11.78	$10.99	$10.52	$9.64	$9.64

*Using additional irrigation labor and grass lined filter strips.

This combination of practices produces costs ranging from a low of about $10 to almost $40 per acre depending on field size and crop. Both alfalfa and citrus trees are assumed to be flood irrigated and the annual cost of additional irrigation labor is estimated between $7.50 and $9.20 per year. Added to this amount is the estimated annual cost of the grass filter strips that varies between $2.14 and $4.28 per acre depending on field size. This results in total costs that vary from $9.64 to $11.78 for tree crops and from $11.34 to $13.48 for alfalfa.

Flood irrigated crops such as hay and tree crops, have the lowest cost of sediment retention, but vary by 22 percent and 19 percent between the 40-acre and 160-acre field sizes. Vegetable and field crop annual costs are relatively stable with respect to field size, ranging between $33.64 and $39.28 per acre.

The least cost sediment retention alternative is the installation of grass lined filter strips (Table 4). Since the grass lined filter strip sediment reduction technique is not crop specific, costs for a 160-acre field are half the costs for a 40-acre field. Implementing the practice would depend entirely on the ability of grass lined filter strips to solely or in combination with other practices meet the objectives of the TMDL, which may be challenging in some areas.

A comparison on a cost-share basis reveals that high cost scenario sediment reduction costs represent increases of less than 1% in per-acre gross production costs for field crops (annual production costs of $500 - $800) and vegetables (annual production costs of $3,000 - $5,000). For non-vegetable row-crops, sediment retention costs are about 2 percent of total production costs, which is about $1,500 per acre.

Table 4. Low Estimate of Annual Costs of Sediment Retention by Fields Size and Crop*

	Field Acreage				
Crop	<=40	>40<=60	>60<=80	>80<=160	>=160
Alfalfa (172,000 ac.)	$4.28	$3.49	$3.02	$2.14	$2.14
Lettuce (29,000 ac.)	$4.28	$3.49	$3.02	$2.14	$2.14
Sugar Beets (36,000 ac.)	$4.28	$3.49	$3.02	$2.14	$2.14
Citrus (4,900 ac.)	$4.28	$3.49	$3.02	$2.14	$2.14

*Using grass lined filter strips.

Considering the amount of reduction in soil erosion, and subsequent delivery to the drainage system, the cost increases associated with the practices reviewed appear reasonable. Some farmers will probably implement other changes in the current irrigation practices, changes that result in a reduced peak volume of discharge. Better management of water discharges will reduce sediment outflow, and in many cases also reduced water inflow.

If you have any questions, please call me at (916) 341-5279.

Attachment

cc: Lori Okun, OCC